05/28/96

Federal Agency (EPA-DOE)
Voluntary Programs - Partial List

- 33/50 Toxics Program
- Pollution Prevention - P^2
- Green Lights
- Energy Star - Buildings, Computers, Residential
- Energy Efficiency - Conservation
- Climate Wise
- Climate Challenge Action Plan - 49 programs
- Golden Carrot Partnerships
- Natural Gas Star
- Agriculture Star
- Landfill Methane Programs
- Coal Bed Methane Programs
- Motor Challenges - Energy Efficient Electric Motors
- Rebuild America
- Clean Cities

State Programs

- Air Help - PRC

Philadelphia Region

- Ozone Action Days

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

AUG 18 1993

AUG 25 1993

OFFICE OF
AIR AND RADIATION

AIR, RADIATION & TOXICS
Division

MEMORANDUM

SUBJECT: VOC Emission Benefits for Nonroad Equipment with the Use of Federal Phase 1 Reformulated Gasoline

FROM: Phil Lorang, Director
Emission Planning and Strategies Division
Office of Mobile Sources

TO: Director, Air Management Division, Region 1
Director, Air and Waste Management Division, Region 2
Director, Air, Radiation, and Toxics Division, Region 3
Director, Air, Pesticides, and Toxics Management Division, Region 4
Director, Air and Radiation Division, Region 5
Director, Air, Pesticides, and Toxics Division, Region 6
Director, Air and Toxics Division, Regions 7, 8, 9, and 10

The purpose of this memo is to provide estimated percent benefits to apply to the exhaust and evaporative VOC (volatile organic compound) categories in the nonroad emission inventories to account for Phase 1 reformulated gasoline use. Included with this discussion are inventory adjustments to account for the RVP of the adjusted base year inventory. Nonroad emission standards will not be in place in time to claim benefits by 1996. Table 1 gives the estimated exhaust and evaporative VOC benefits in Class B and C areas, for Phase 1 reformulated gasoline blends relative to the adjusted base year inventory (9.0 psi RVP for Class C areas; 7.8 psi RVP for Class B areas).

Table 1. Exhaust and Evaporative VOC Benefits with Use of Phase 1 Reformulated Gasoline for Nonroad Equipment Relative to the Adjusted Base Year Inventory.

	Exhaust	Evaporative
Class B	3.3%	3.2%
Class C	3.3%	3.5%

Background

As you know, last September OMS released guidance containing nonroad inventories for use in 33 ozone and/or CO nonattainment areas, based on the EPA November 1991 nonroad report. Many states have requested that we provide adjustments to apply to the 2-stroke and 4-stroke nonroad inventories in ozone nonattainment areas, to account for exhaust and evaporative emission benefits associated with the use of federal reformulated gasoline in 1995.

Although refueling emission benefits are also associated with the use of reformulated gasoline, adjustment of inventories to account for these benefits is not necessary in most cases. This is because nonroad refueling emissions not only were included in the nonroad inventories, but the refueling emissions component of area source inventories prepared under other guidance is also likely to include nonroad refueling emissions, unless the state took special care to subtract nonroad gasoline use from total gasoline sales. Thus, nonroad refueling emissions may be "double-counted" in some cases. States may correct this at their option. However, since nonroad refueling emissions are such a small fraction of the total inventory, this is not significant. If these area source inventories do include nonroad refueling emissions, states are already getting credit for reductions in nonroad refueling emissions. If the nonroad refueling component has been removed from the area source inventory, however, a benefit may be applied to nonroad refueling emissions in the mobile source inventory. Benefits which may be applied to nonroad refueling emissions are discussed later in this memo.

EPA suggests applying the exhaust and evaporative emission benefits in Table 1 to output from the Aerometric Information Retrieval System/Area and Mobile Source (AIRS/AMS) inventories, given in the AMS 831 Emissions Summary Report. Although this memo estimates separate benefits for exhaust, evaporative and refueling nonroad emissions, the AMS 831 Emissions Summary Report provides total VOC emissions estimates (exhaust, evaporative, refueling and crankcase emissions combined). For nonroad equipment, this summary report provides total VOC emissions estimates for the following components: 2-stroke, 4-stroke, and diesel off-highway land vehicles and 2-stroke, 4-stroke, and diesel recreational marine vessels. Thus, exhaust, evaporative and refueling emissions must be separated from these total VOC estimates in order to apply benefits associated with the use of Phase 1 reformulated gasoline. The attachment lists the exhaust, evaporative and refueling percentages of the gasoline components (2-stroke and 4-stroke combined) for each of the 27 nonroad inventories from areas in ozone nonattainment (six of the inventories are for areas in nonattainment for CO but in attainment for ozone; thus, these six inventories contain only CO emissions data). The percentages in the attachment are given for the sum of the 2-stroke and 4-stroke inventories. Thus, states should combine all 2-stroke and 4-stroke

nonroad components in the AMS 831 Emissions Summary Report to obtain the total VOC emissions from gasoline nonroad vehicles, and then apply these percentages.

In Class B areas, the evaporative nonroad inventory derived from AMS must first be reduced by 8.9%, to account for the fact that the RVP required to be assumed for the adjusted base year inventory (7.8 psi) is lower than the RVP assumed in the nonroad evaporative inventory (9.0 psi). This adjustment is discussed later in the memo. No adjustment is required for Class C areas since the AMS nonroad inventory and adjusted base year inventory are both based on use of 9.0 psi RVP fuel.

California Air Resources Board (CARB) staff reportedly have also estimated benefits for nonroad equipment with reformulated gasoline use. Due to the lack of emissions data for nonroad vehicles running on reformulated gasoline, CARB categorized nonroad equipment types based on similarity to categories of onroad vehicles and ran EMFAC7, using pre-control onroad vehicles as surrogates for nonroad equipment. This approach is similar to the one used by EPA, as described below.

Exhaust VOC Benefit

A 1988 EPA technical report, "Guidance on Estimating Motor Vehicle Emission Reductions from the Use of Alternative Fuels and Fuel Blends" (EPA-AA-TSS-PA-87-4) and a supplemental 1988 EPA report, "Derivation of Technology Specific Effects of the Use of Oxygenated Fuel Blends on Motor Vehicle Exhaust Emissions" (EPA-AA-TSS-PA-88-1), provides technology-specific exhaust effects of oxygenated gasoline blends for motor vehicles. The VOC benefit for a 2.0% oxygen blend with the same RVP as the baseline gasoline is 3.0% for noncatalyst-equipped motor vehicles. This estimate is based on a sample size of 48 vehicles from several different studies. Few or no non-catalyst vehicles have been tested with oxygenated or reformulated gasoline since these studies. It makes sense to apply the findings from these non-catalyst vehicles to nonroad engines, since that technology (versus catalyst technology) is most like what is used in nonroad engines.

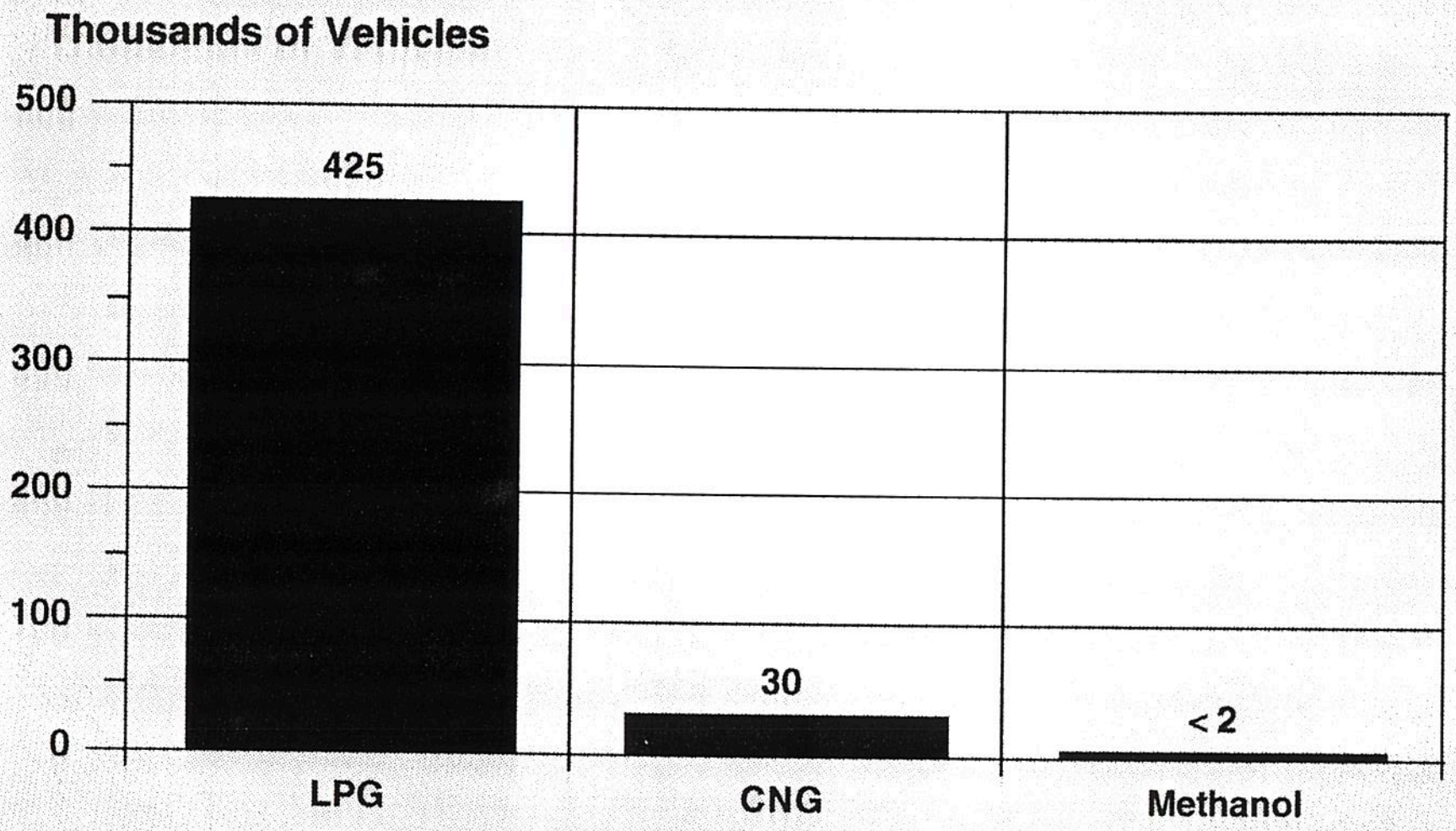
MOBILE5a also includes an additional adjustment for Phase 1 reformulated gasoline relative to a non-reformulated 2.0% oxygenated gasoline in Class B and C areas to account for fuel effects other than oxygen content on exhaust emissions. This adjustment factor is approximately 1.1 for both Class B and C areas. Thus, the exhaust VOC benefit for Phase 1 reformulated gasoline use in non-catalyst vehicles is about 3.3%. This oxygenated fuel effect has been incorporated into MOBILE5a and is applied to reformulated gasoline benefits for non-catalyst vehicles. Overall highway vehicle exhaust benefits from reformulated fuel are larger than 3.3% because catalyst equipped

Alternative Fuels Overview

Retail Demonstration Sites

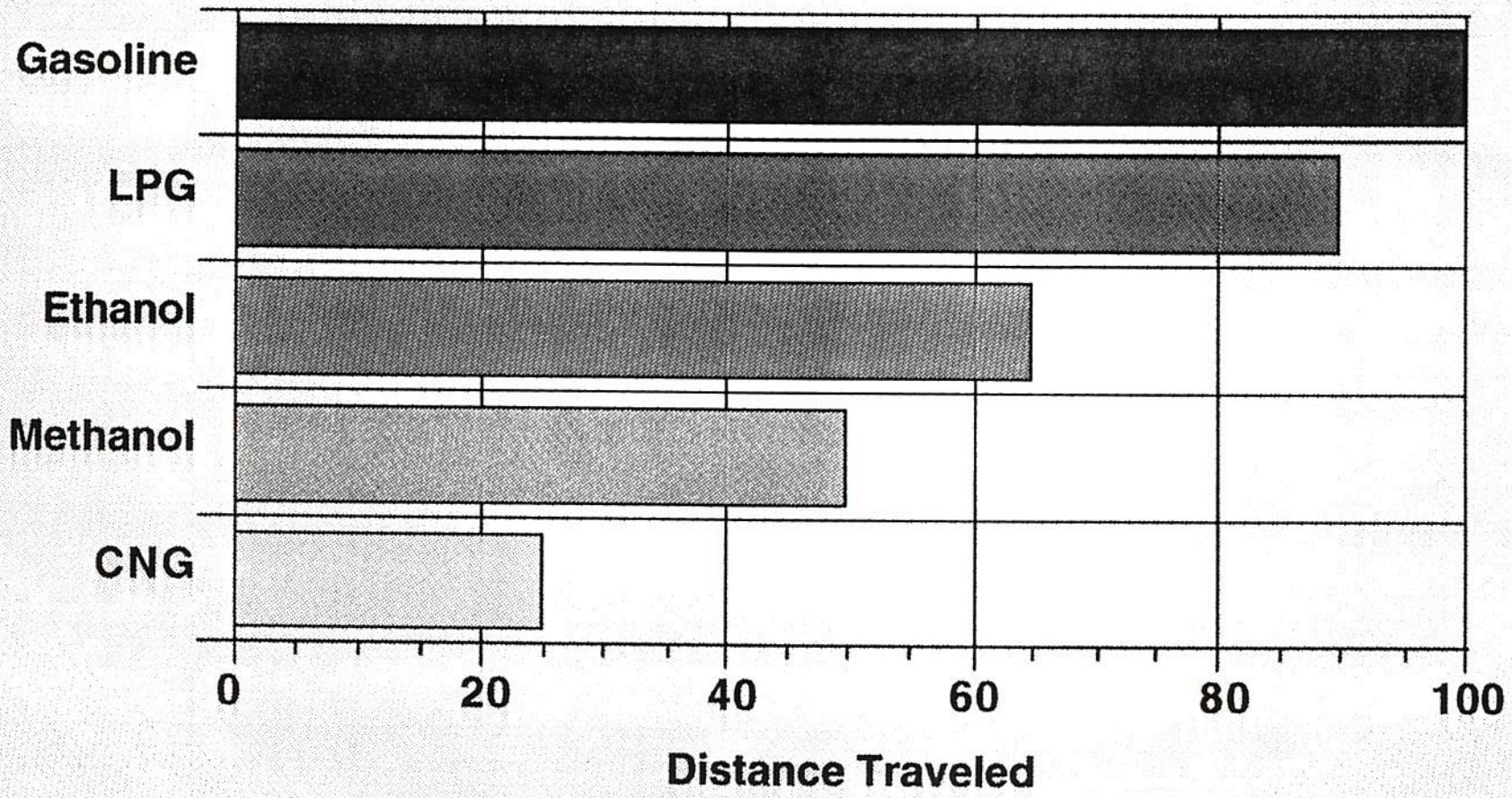
M-85	Washington, DC
	Dearborn, MI
	Troy, MI
	Queens, NY
	Philadelphia, PA
	Baltimore, MD
E-85	Washington, DC
LPG	West Chester, PA
	Alexandria, VA
CNG	Philadelphia, PA
	York, PA (Second Half, 1994)
	Syracuse, NY (Second Half, 1994)

Number of Alternative Fueled Vehicles United States



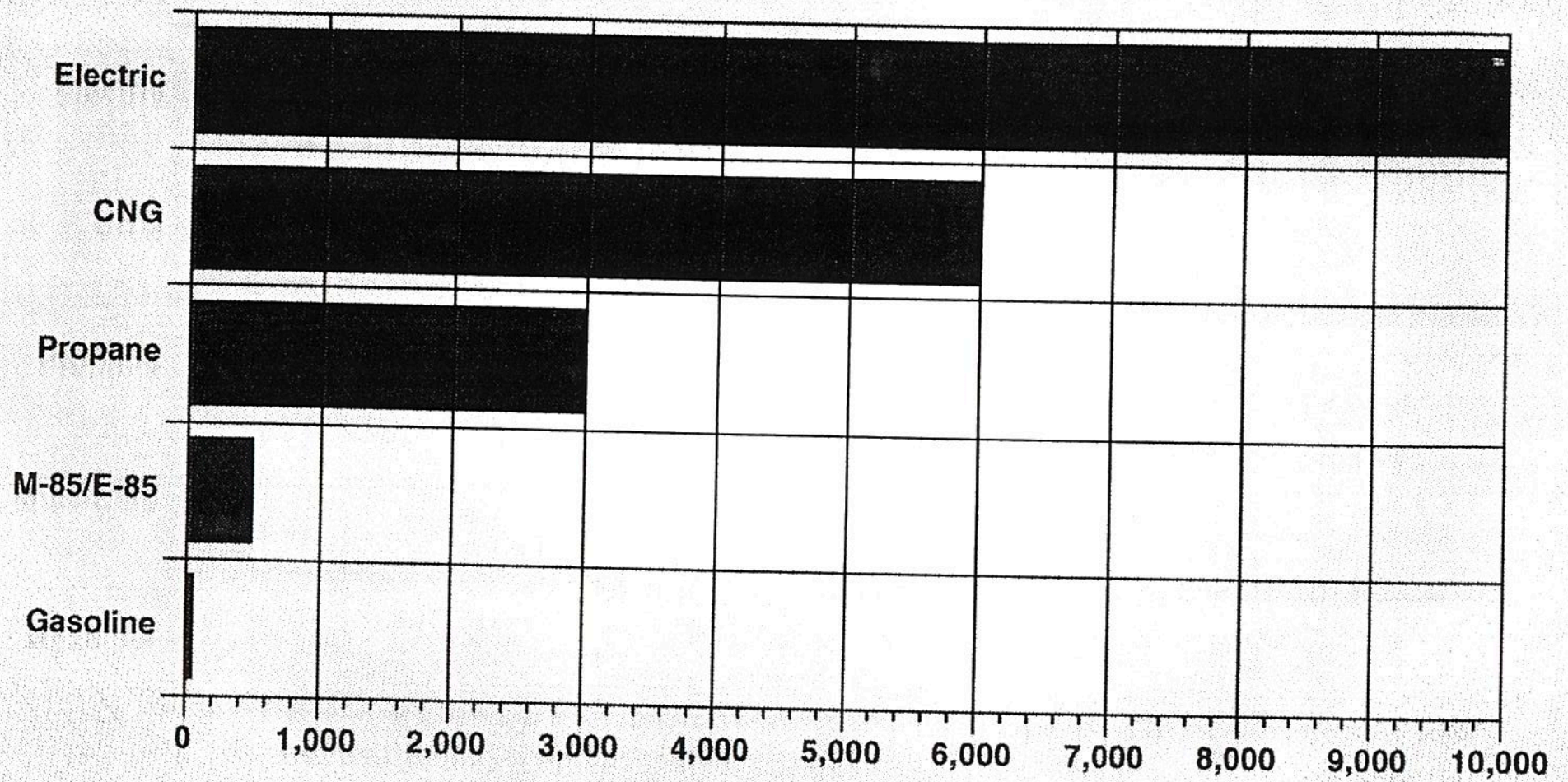
Source: NPGA, US DOE

Driving Range



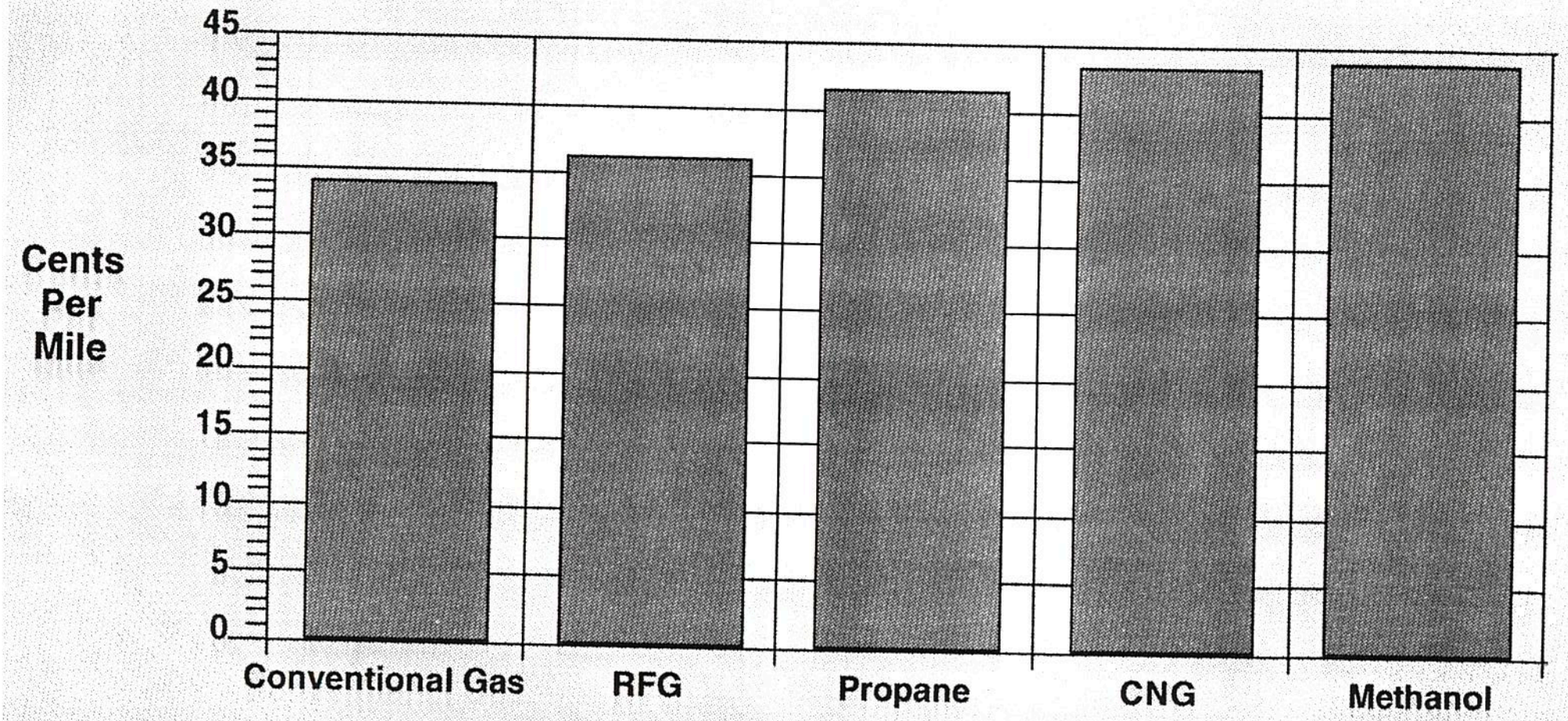
Equal Fuel Volume - Current Technology

Incremental Vehicle Cost



SUNOCO

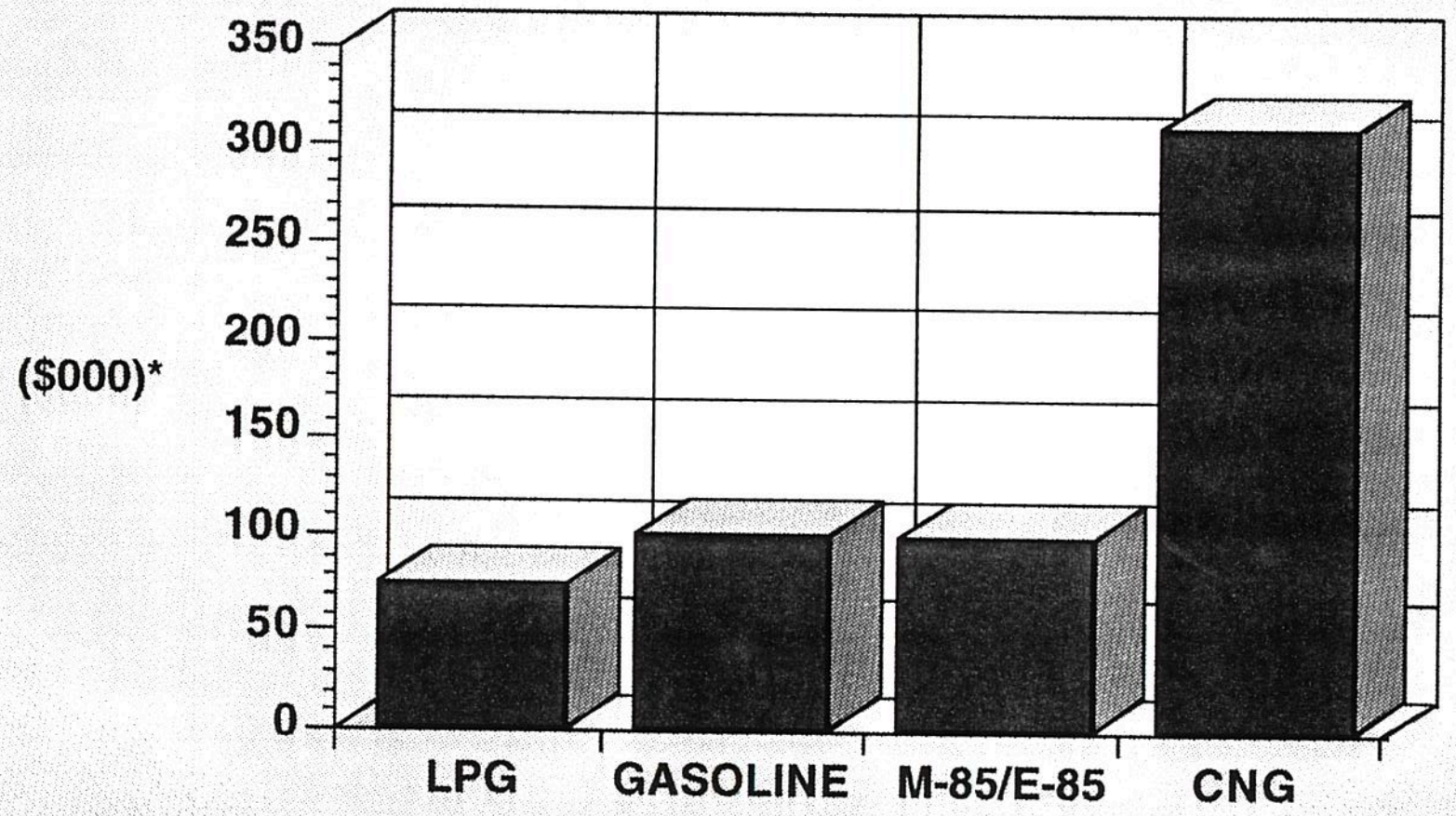
Fuel Cost Comparison



Source: Battelle Report of Federal Express Study
Cost Difference of 1 Cent Could Be $10,000

Public Refueling

Alternative Fuels Installation Costs



* Cost Included Installation & Equipment, Eg. Tanks, Dispensers, Card Readers, Compressors, Etc.

Operating Costs Compared to Gasoline

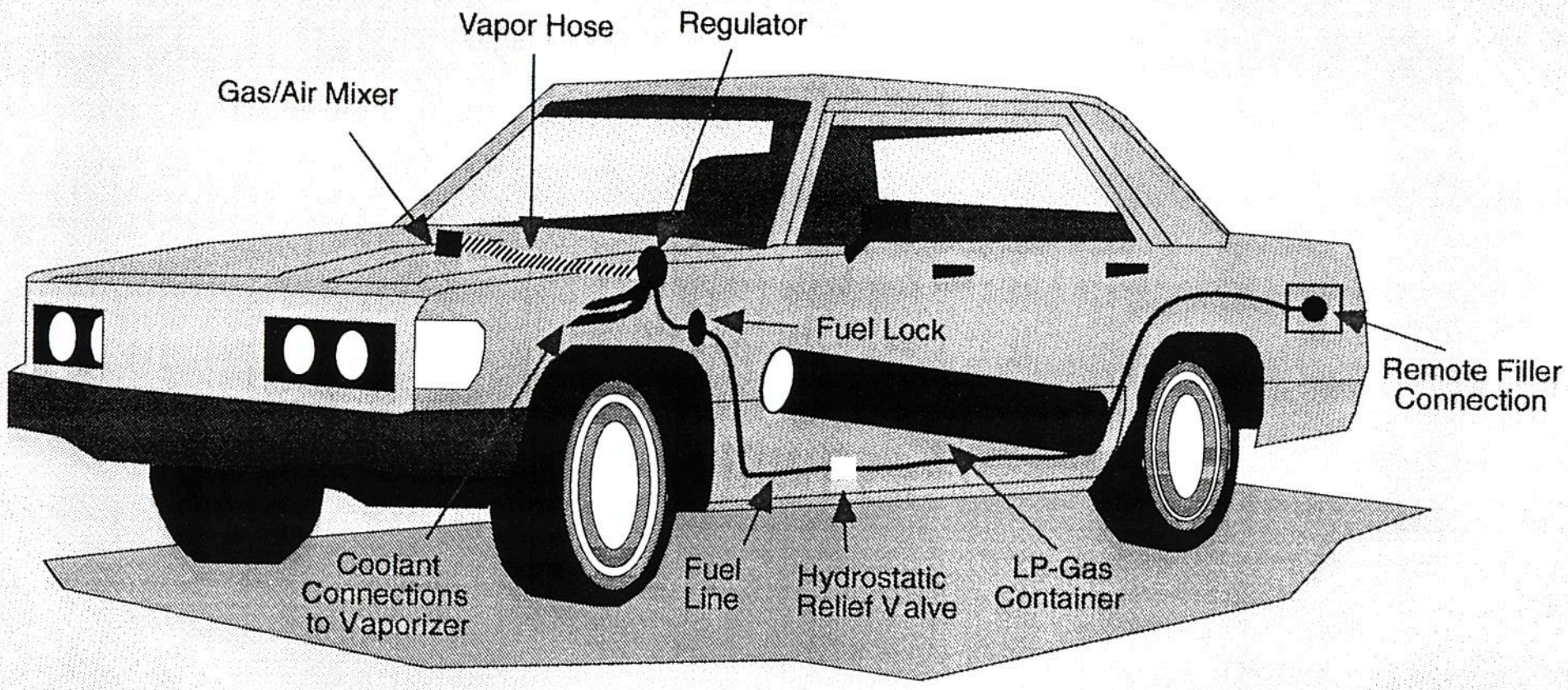
	LPG	*M-85*	*E-85*	*CNG*
Delivery	More*	Same	Same	Less
Credit Card	Same	Same	Same	Same
Manpower	Same	Same	Same	Same
Maintenance	Same	Same	Same	More
Utilities	Same	Same	Same	More

* Delivery costs would decrease with increase in tank size

Public Refueling Installation Costs
Alternative Fuels Comparison

	Gasoline	E-85/M-85	LPG	CNG
Install & Equipment				
Capacity	10,000 Gallon	10,000 Gallon	2,000 Gallon	250 Gallon Equiv.
U/G FG Tank & FG Piping	18,000	18,000	-	-
A/G ASME Tank & Steel Piping	-	-	13,000	-
A/G ASME Cylinders & Stainless Tubing	-	-	-	51,000
Pump or Compressor	1,100	1,100	1,000	91,000
Dryer & Booster	-	-	-	55,000
Dispenser	8,900	8,900	14,000	34,000
Card Reader	15,000	15,000	15,000	15,000
Graphics	1,500	1,500	2,000	1,500
Site Work, Installation & Permits	57,500	57,500	34,000	65,000
Total	$102,000	$102,000	$79,000	$312,500

Installation of LPG Gas Systems



Summary

- Gasoline best fuel with economic and environmental record
- Propane best alternative fuel providing performance and emissions benefits at economical price
- CNG provides emissions benefits, but involves costly refueling equipment which requires extensive maintenance
- M-85 is not used -- most drivers prefer gasoline for their FFV's/VFV's
- Electric vehicles are costly. Analysis must include total system emissions.

EVAMERICA USDOE

GENERAL MOTORS EV1

VEHICLE SPECIFICATIONS

PURPOSE–BUILT VEHICLE
Base Vehicle: 1997 EV1
VIN: 4G5PX2250T0100009
Seatbelt Positions: Two
Standard Features:

Heat Pump Climate Control System	
Cruise Control	Power Door Locks
Dual Air Bags	Power Windows
Front Disc Brakes	Power Steering
Anti–Lock Brakes	Front Wheel Drive

Regenerative Braking
Daytime Running Lights
AM/FM Stereo w/Cassette and CD Player w/4 Speaker System
ElectriClear Windshield
Check Tire Pressure System
High Voltage Isolation Assurance
Welded & Bonded Aluminum Alloy Body
Electronic Key Pad Entry/Vehicle Activation System
110V 1.2 kW Convenience Charger

BATTERY
Manufacturer: Delphi
Type: Valve Regulated Lead Acid
Number of Modules: 26
Weight of Module: 18.8 kg
Weight of Pack: 1175 lbs
Pack Location: T-Pack Integral
Nominal Module Voltage: 12 V
Nominal System Voltage: 312 V
Nominal Capacity (C/2): 53 Ah

WEIGHTS
Design Curb Weight: 2970 lbs
Delivered Curb Weight: 2922 lbs
Distribution F/R: 53/47 %
GVWR: 3410 lbs
GAWR F/R: 1705/1705 lbs
Payload: 440 lbs
Performance Goal: 400 lbs

DIMENSIONS
Wheelbase: 98.9 inches
Track F/R: 57.9/49.0 inches
Length: 169.7 inches
Width: 69.5 inches
Height: 50.5 inches
Ground Clearance: 4.2 inches at GVWR
Performance Goal: 5.0 inches at GVWR

CHARGER
Location: Off–board
Type: Delco Electronics Inductive 6.6 kW
Input Voltages: 156 to 260 VAC

TIRES
Tire Mfg: Michelin
Tire Model: Proxima RR Radial
Tire Size: P175/65R14
Tire Pressure F/R: 50/50 psi
Spare Installed: No; Self Sealing Tires

PERFORMANCE STATISTICS

ACCELERATION 0-50 mph
At 100% SOC: 6.3 sec
At 50% SOC: 6.7 sec
Max Power: 116.4 kW
Performance Goal: 13.5 sec at 50%SOC

MAXIMUM SPEED @ 50% SOC
At ¼ Mile: 78.9 mph
In 1 Mile: 80.4 mph
Performance Goal: 70 mph in one mile

CONSTANT SPEED RANGE @ 45mph[1]
Range: 135.2 miles
Energy Used: 15.58 kWh
Average Power: 5.19 kW
Efficiency: 115 Wh/mile
Specific Energy: 31.9 Wh/kg

CONSTANT SPEED RANGE @ 60 mph[1]
Range: 89.1 miles
Energy Used: 14.58 kWh
Average Power: 9.79 kW
Efficiency: 164 Wh/mile
Specific Energy: 29.8 Wh/kg

DRIVING CYCLE RANGE[1]
Range per SAE J1634: 78.2 miles
Energy Used: 12.84 kWh
Average Power: 4.06 kW
Efficiency: 164 Wh/mile
Specific Energy: 26.3 Wh/kg
Performance Goal: 60 miles

BRAKING FROM 60 mph
Controlled Dry: 171.0 feet
Controlled Wet: 214.8 feet
Panic Wet: 211.9 feet
Course Deviation: 0.0 feet

HANDLING
Avg Time @ 90% SOC: 55.8 sec
Avg Time @ 50% SOC: 55.4 sec
Avg Time @ 20% SOC: 55.4 sec
Avg Dodge Neon Time: 54.62 sec

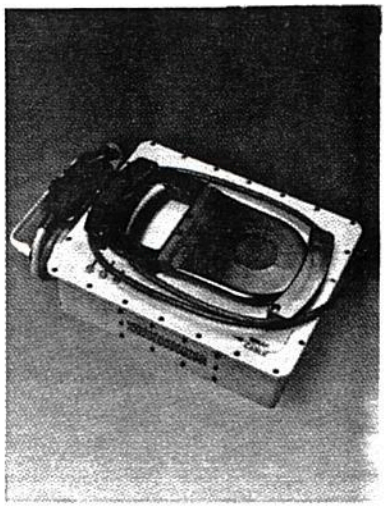
GRADEABILITY (Calculated)
Maximum Speed @ 3%: 79.0 mph
Maximum Speed @ 6%: 78.2 mph
Maximum Grade: 53.2 %
Time on 3% Grade: 28 min 57 sec
Performance Goal: 15 min

CHARGING EFFICIENCY
Efficiency: 248 Wh–AC/mile
Energy Cost @ 10¢/kWh: 2.48 ¢/mile

CHARGER[2]
Max Charger Ground Current: <0.01mA
Max Battery Leakage Current: <0.01mA
Max DC Charge Current: 16.83 Amps
Max AC Charge Current: 28.96 Amps
Pwr Factor @ Max Current: 1.00
THD(V)(I) @ Max Current: 2.78/4.80%
Peak Demand: 5.93 kW
Time to Recharge: 5 Hrs 18 min
Performance Goal: 8 hours

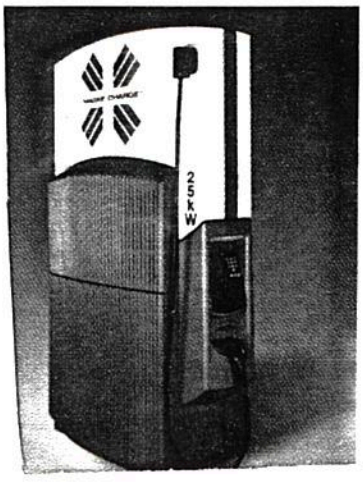
TEST NOTES:
1. At various times during these range tests the Battery Life, Reduced Performance, Service Soon and Service Now telltales illuminated.
   Charging time was extended due to high temperature conditions.
   Specific Energy values were calculated using the number of modules times the module weight.
2. The battery pack data collection voltage signal was reduced 100:1 through a voltage divider installed by General Motors. This was for personnel protection.
5. The Standing Water Test was conducted with a water depth of six inches versus eight inches.

This vehicle meets all EV America Minimum Requirements listed on back.
Values in red indicate the Performance Goal was not met. • All Power and Energy values are DC unless otherwise specified.



1.5 kW
Portable

6.6 kW
Floormount and
Wallmount



25 kW
Opportunity
Charge Station